OIDA Annual Membership Forum
PCAD Joint Venture Team
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The Photonics Computer-Aided Design (PCAD) Joint Venture

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PCAD Technical Contacts

Consortium Director -	Dr. Al Mondelli (SAIC)
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Agilent Technologies	Dr. Mitch Mlinar
Columbia University	Professor Richard Osgood
Nortel Networks	Dr. Gary Mak
RSoft Inc.	Dr. Rob Scarmozzino
SAIC	Dr. Spilios Riyopoulos
SDL	Dr. Mehrdad Ziari
Telcordia Technologies	Dr. Janet Jackel

representing the PCAD team.

Outline

- Motivation
- Why NIST/ATP
- Technical Program Goals
- Joint Venture Team Activities and selected results
- Demonstration
- What PCAD means for OIDA
- Conclusions

Motivation

- Historic development of high performance microelectronics and impact of simulation
  - Single material system (Si)
  - Essentially one device type (FET)
- Growing multi-faceted Photonics Marketplace
  - Networks, Datacom, Lighting, Healthcare, Automotive, Military, Computers
- Optoelectronics Industry
  - Many material systems
  - Widely varying device types
  - No “standard” widely used simulation technology

Why PCAD?

- Existing OE Simulation Tools…
  - Isolated, non-interoperable tools
  - Inefficient design cycles
  - Primarily foreign based tools and frameworks cause delayed impacts
  - *Resulting in poorer product competitiveness*
- The PCAD Consortium:
  - A multiyear program to build an open, integrated, hierarchical simulation environment with an initial experimentally validated tool set
- PCAD Consortium Goals:
  - Shortened photonics design cycle time
  - Reduced product time-to-market
  - Improved reliability
  - Lower costs at every level

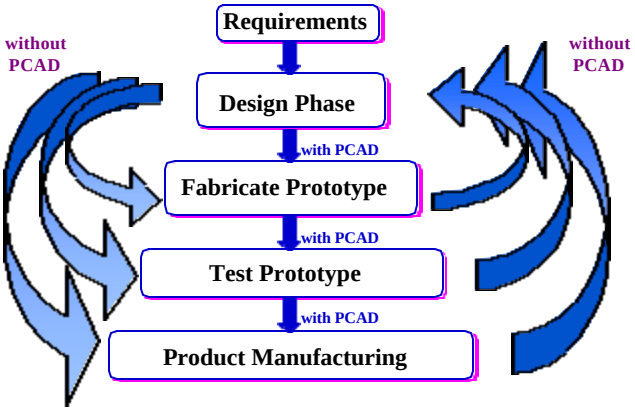
Why NIST/ATP Funding?

- Tool development without NIST/ATP is transaction based
  - Product oriented pair-wise interactions only
  - No sustained collaboration for integration
  - No focused multi-party research effort
  - No open interfaces - proprietary codes, interfaces, GUI
- PCAD supported in part by NIST/ATP is Collaborative
  - Long term focused research with Partner co-investment
  - Integrated tool and framework development
  - Interactions between tool developers and manufacturers
  - Accelerated commercialization and market growth
  - Prototype for future standards

PCAD Joint Venture Team

Type	Organization	Strengths
Optoelectronics Manufacturers	SDL Nortel Networks	• Commercial OE hardware sales • Internal R&D
Commercial Software Vendors	HP/EEsof Div. (Agilent Technologies) RSoft	• Commercial software sales • Leading edge photonic tool dev.
Commercial & Government Services	Telcordia Technologies SAIC	• Consulting services • Software licensing • Vendor-neutral • Leading-edge R&D
Universities	Columbia	• Contract R&D • Leading edge technology expertise

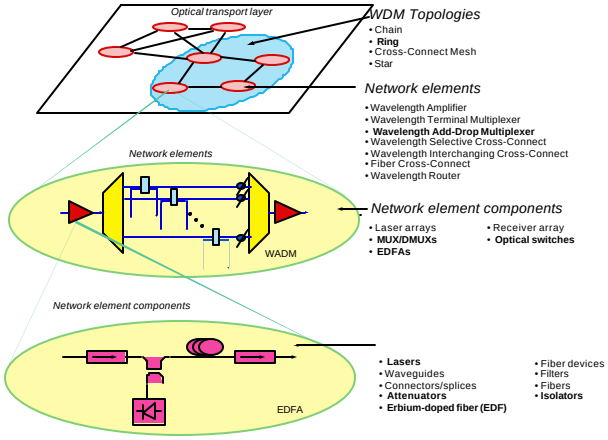
The PCAD Vision



- Goal of PCAD is elimination of design-build-test cycles.
- Each cycle is more expensive than the nested cycle.

Multi-Level Photonics CAD Simulation Environment

Optical Transport Layer Simulation



Threads toward a tapestry

- PCAD incorporates
  - Software developers
  - Actual manufacturers who use the codes
  - Test and validation activity
- Tasks
  - Requirements
  - Hierarchical Framework development
  - Tool development at different layers
  - Test and Validation activities
- **Simulation at different levels of abstraction**
- **Address issues that OE manufacturers really care about**

RSoft's Research

RSoft, Inc. Research Software

- Enhance the capabilities and extend current products covering both device and system/link
  - *BeamProp*
  - *FullWAVE*
  - *LinkSIM*
- Develop prototypes of new device and component level CAD tools
  - Edge-Emitting and VCSEL lasers
  - Amplifiers
  - Modulators
  - Wavelength-domain integrated circuit simulators
- Definition of framework requirements
- Integration of device and link-level tools
- Integration of link and network-level tools

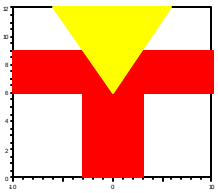
Agilent/HP EEsof

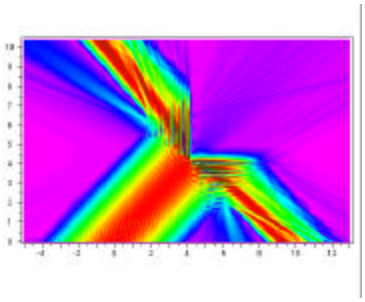
Agilent

- Advanced Design System as a starting point framework
  - Simulate the entire communications signal path
  - RF, µW, DSP, Photonics & System level design
  - Layout for high frequency circuits
- Enabling Technologies
  - 3D finite element simulator for passive 3D structures
  - Momentum for planar EM passive circuit analysis
  - IC-CAP for nonlinear active device modeling
  - Libraries of over 90,000 active and passive parts
- Links to other cad software (Mentor, Cadence, …)

Columbia U. Research

- Applications of photonic crystal devices to magnetic materials
- Modeling of traveling wave $LiNbO_3$ modulators
- Ongoing software prototyping and evaluation
- Development of bidirectional beam propagation algorithms:
  - Increased speed, reduced memory for modeling of reflective photonic structures:
  - eg. T-splitter:





Nortel Networks

- Nortel will ensure that a fully-integrated PCAD simulation system provides real value in the design and manufacture of photonic components.
- Nortel's research
  - helping to set user requirements for PCAD tools,
  - comparing model predictions to experimental data on device, optical link, and network performance
  - Example:
    - will use a prototypical device (e.g. optical modulator), to validate the module level model (electro-optical and electrical) and compare with optical link performance measurements and actual estimates of manufacturing yield

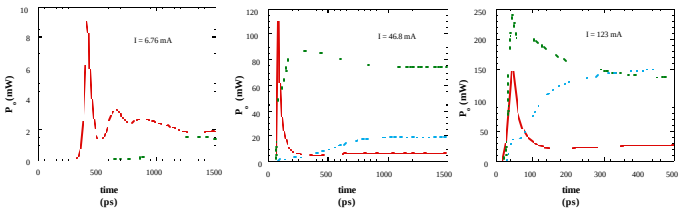
SDL Research

- Representation of photonic manufacturing
- Definition of software requirements from a user's perspective
- Experimental Test and Validation Activities
- SDL will use the tools in design, fabrication and testing and will provide feedback to tool developers
  - Model accuracy
  - Compatibility with manufacturing environment
    - ⇨ Measurable & relevant input and output parameters

SAIC Research

- **Physics-based Device Modeling**
- **Framework activities**
- **Example: Fast multi-mode VCSEL modeling**
  - **Expansion in cavity eigenmodes**
  - **Retains 2-D effects without finite spatial grid**
  - **Multimode interactions / hole burning included**
  - **Runs in tens of seconds**

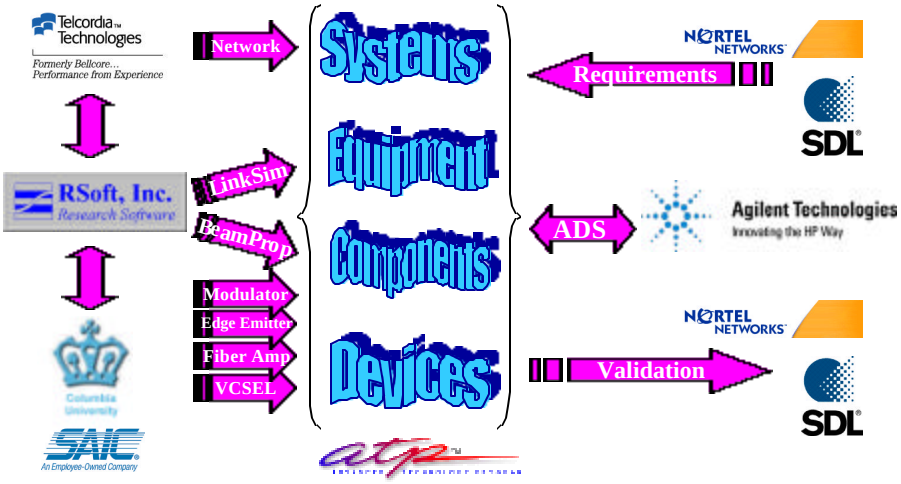
Power output vs. time (three modes included)



Telcordia Technologies Research

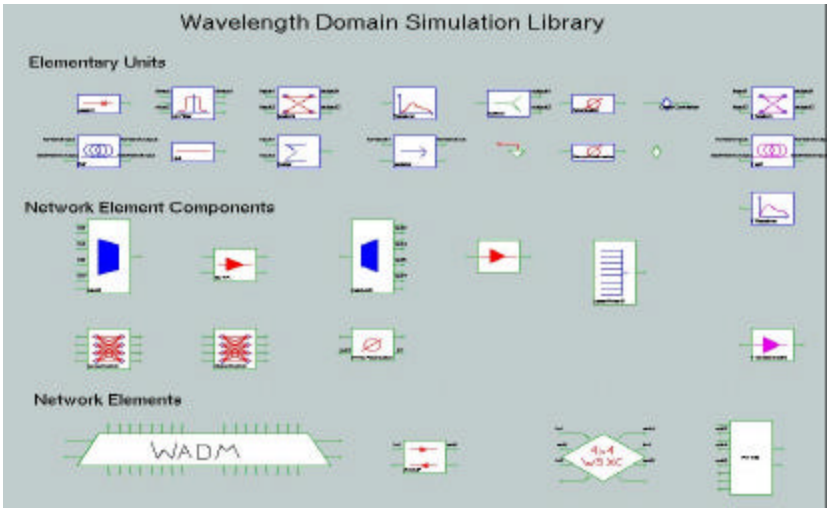
- Program Technical Lead and Co-ordination
- Development/enhancement of a wavelength domain network level simulator
- Integration of network and link level tools (with RSoft)
- Definition of tools requirements at multiple levels
- Co-ordinate testing and validation activities

PCAD Tapestry

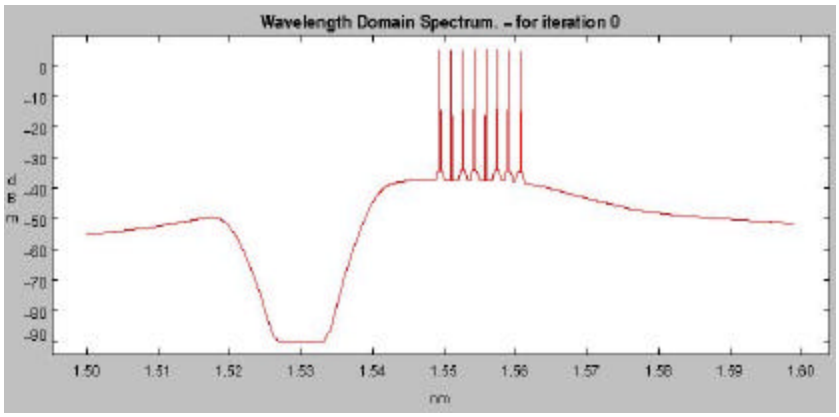


Demonstration

Example Simulation Library



Output after WADM



Many paths to success